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Rationale, considerations, and goals for atrial fibrillation centers of excellence: A Heart Rhythm Society perspective

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ABBREVIATIONS **AF** = atrial fibrillation; **CHIP** = Children's Health Insurance Program; **CIED** = cardiac implantable electronic device; **CoE** = center of excellence; **CQI** = continuous quality improvement; **EHR** = electronic health record; **EMR** = electronic medical record; **HRS** = Heart Rhythm Society; **LAA** = left atrial appendage; **MIPS** = Merit-based Incentive Payment System; **OAC** = oral anticoagulation; **PRO** = patient-reported outcomes; **QI** = quality improvement; **QoL** = quality of life; **QPP** = Quality Payment Program; **SDM** = shared decision-making (Heart Rhythm 2020;17:1804–1832)

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Section 1 Introduction

Atrial fibrillation (AF) remains an important global problem.[1–3] AF continues to lead to poor health outcomes, including reduced quality of life (QoL) and increased risks of heart failure, cognitive impairment, stroke, and death.[4,5] Moreover, it has a significant financial impact on health care systems and their associated economies.[6–8] In order to improve care for patients with AF, there is an increasing recognition that current care must evolve. Health care organizations should move from a system of siloed outpatient and inpatient clinicians and health care facilities to a system of integrated, coordinated, and patient-centered AF centers. The goal of an AF "center of excellence" (CoE) is to improve outcomes by providing a better patient experience and delivering high-quality, guideline-recommended, state-of-the-art care.

This manuscript builds on the work of a diverse, multiple-stakeholder Think Tank meeting and multidisciplinary Interpro Forum educational activity held in January 2019, both led by the Heart Rhythm Society (HRS). When examining the current clinical landscape, the Think Tank concluded that there is a clear need for AF CoEs to improve AF care and its delivery. In this manuscript, HRS hopes to accelerate this evolution by reviewing the rationale for AF CoEs, the available evidence for integrated and multidisciplinary care, and future challenges and opportunities. The document also defines the key priorities to be used as a guide for HRS and its diverse stakeholders to build consensus on defining the core components of an AF CoE.

Section 2 Background and rationale

AF is the most common arrhythmia throughout the world.[1–3] Demographic trends with an aging population, higher rates of associated comorbidities that predispose to AF, and improvements in detection and treatment[9–16] all combine to accelerate an existing AF epidemic and generate important public health implications.

Despite the publication and widespread dissemination of evidence-based practice guidelines for managing all aspects of AF care, underdiagnosis, inadequate treatment, and improper care variation,[17] especially among noncardiovascular clinicians, are widely prevalent across all geographies.[18] For example, the majority of patients with known AF who experience an acute ischemic stroke have not received adequate anticoagulation.[19,20] Failure to adhere to evidence-based practice guidelines leaves the public vulnerable to morbidity and mortality that could be avoided.

The increased incidence and prevalence of AF also produce a significant economic burden for health care systems and for society as a whole,[6–8,17] requiring more health care resources[21–24] in both newly diagnosed and previously diagnosed AF patients.

The complexity of AF care delivery is compounded by the overall manner in which that care is provided in different regions and the growing need to manage other comorbidities such as obesity, hypertension, diabetes, cardiovascular disease, sleep

apnea, and other conditions that are known to contribute to the initiation and progression of AF.[25] Effective management of these comorbidities requires the expertise of other medical disciplines and the participation of multiple health care providers, including allied health care professionals. On occasion, AF care may become focused solely on the management or restoration of sinus rhythm while the other aspects of AF may be neglected. In other cases, patients with AF are managed by noncardiovascular specialists who may have difficulty staying up to date on guideline-directed treatment of AF. It is our belief that a patient-centered, multidisciplinary, and integrated model of care can address all aspects of AF in a manner that should create greater value by improving clinical outcomes and decreasing costs.[26,27]

Opportunities to improve care of AF

There are significant opportunities at multiple levels to improve care of patients with AF. One such important opportunity is the delivery of care for stroke prevention. While guideline-directed stroke prevention therapy has been shown to reduce stroke and improve all-cause survival,[4,5,28–32] large cohort studies and international registries consistently demonstrate underuse of oral anticoagulation (OAC) in appropriate patients,[33–38] overutilization in low-risk patients, and ineffective dosing.[39–42] All of these practices are associated with poor outcomes. Patient-related issues (eg, concerns over risk versus benefit, side effects, an understanding of need for compliance, and cost),[43] physician-related factors (eg, overestimation of bleeding risk, underestimation of net clinical benefit, etc),[44,45] and disjointed health care systems all limit the adoption of evidence-based approaches. The establishment of effective quality improvement programs has improved rates of appropriate OAC for eligible stroke-reduction patients to >95%.[46] Similar variation exists in coordinating effective rate and rhythm control approaches and in maximizing procedural outcomes. These prevailing circumstances create an important opportunity to improve care in a significant way.

Discrepancies in care delivery as a result of race, ethnicity, and sex also have resulted in differences in patient education, clinic access, OAC treatment, antiarrhythmic drug therapy, and ablation.[47–49] By establishing programs focused on minimizing these disparities, we believe there is an important opportunity to improve the quality and equality of care and thereby improve outcomes for patients with AF.

The existing uncoordinated manner in which AF risk factors (eg, hypertension, diabetes, obesity, sleep apnea, etc) and comorbidities are treated results in greater AF progression and untoward cardiovascular outcomes.[50,51] Randomized trials utilizing a multidisciplinary, integrated AF clinic approach to AF management, with a focus on risk factor management, have resulted in reductions in wait times for specialist assessment, emergency department visits, hospitalizations, and mortality.[52] The development of these clinics requires expert staff, collaboration, and special resources that carry significant costs. These requirements limit the widespread initiation of these centers.

Section 3 Building a comprehensive AF program: Components and key opportunities

Goals of AF CoE

There are four main pillars in the clinical management of AF. These pillars include 1) risk factor management, 2) stroke prevention, 3) rate control, and 4) rhythm control. The goal of AF CoEs is to deliver these crucial pillars of care while providing a better patient experience by delivering patient-centered, high-quality, guideline-recommended, and state-of-the-art treatment.

Identification of patients

An important first step in creating an AF CoE is the identification and referral of patients who would benefit from integrated and specialty care. While an important goal is for all patients to have access and benefit from these centers, at present this remains an aspirational goal. The unique paradigms and health economics of different health care systems have implications on who can be treated in such centers. However, centers should have a systematic method of identifying at-risk patients who have AF. At-risk patients might include those with risk factors, those not receiving guideline-directed therapy, or those whose risk factors are not adequately or completely treated. Identification of patients who can benefit from integrated and specialty care inherent to an AF CoE can also help ensure that adequate resources can be appropriated to AF clinics. AF CoEs also should have systematic methods of outreach to persons with AF in the community, including educational programs and initiatives to improve awareness of AF.

Appropriate clinician roles and resources

Development of a comprehensive AF CoE requires appropriate staffing and dedicated clinic(s) that focus on the care of patients with AF. Centers should commit to multidisciplinary and broad-based development. Centers may choose to start by addressing specific aspects of the four pillars of care. Some centers may choose to concentrate their initial efforts on patient access to AF clinics, while others may focus on patient selection for ablation or on stroke prevention. Similarly, the development of specific clinical personnel may vary. Nonetheless, relying on a single clinician to manage AF patients is no longer a feasible model in most, if not all, health care systems across the world. As clinician burdens continue to increase, providing comprehensive AF care is best accomplished through a team-based approach. This requires identification, referral, and management of patients with AF in a coordinated fashion.

Of particular importance is timely access to care when patients are acutely symptomatic. These patients may present to urgent care, the emergency room, primary care, or cardiology clinics. Additionally, pathways and systems are needed to help ensure continuity of care as patients progress through these care encounters. Alternatively, newly diagnosed asymptomatic AF patients, or those with AF and a rapid ventricular rate, may be discovered in preoperative settings, outpatient clinics, or at home with wearable patient monitors or smartphone-based or direct-to-consumer applications.

Appropriate triage in these settings has the potential to minimize unnecessary emergency room visits, hospitalizations, and testing and improve patient satisfaction. This triage may be enhanced by direct phone access to knowledgeable staff, such as an appropriately trained nurse or medical assistant in an AF clinic. Same-day or next-day appointments are frequently required to avoid hospitalization. These appointments are intended to provide guideline-directed management of AF. Having appropriately trained nurses, advanced practitioners, clinical pharmacists, and technicians who can assist physicians to manage patients allows for patients to be seen in a timely manner. For patients presenting to the emergency room, protocols for triage and outpatient management can lead to reductions in hospitalizations and positive outpatient outcomes.[53,54]

Long-term management of AF is most efficiently accomplished with coordination between all clinicians, including nurses, advanced practitioners, cardiologists, electrophysiologists, and primary care physicians. Availability of various types of practitioners may vary throughout the world, and the optimal approach may vary by region. CoEs should provide and excel at fundamental AF management, including assessment and implementation of stroke prevention, rate and rhythm management, and risk factor modification. CoEs with electrophysiologists can also provide specialized management options, including initiation and/or adjustment of antiarrhythmic therapy, catheter ablation, and cardiac implantable electronic devices (CIEDs). Primary care physicians must also play an important role in CoEs through engaging patients for assessment and management of noncardiac comorbidities that often drive AF progression as well as ensuring early initiation of anticoagulation upon AF diagnosis in patients at risk.

Developing a comprehensive care team

Development of a comprehensive and integrated care team is important to provide patient care along a continuum and in different settings (see Section 4). Patients with AF have multiple touch points within the health care system that are often highly varied across physical geographies, virtual interactions, specialties, and time (Figure 1). Coordinating the activities of all of these health care staff so they are efficient and patient-centered is important when designing integrated AF care programs.

Coordination of team members and establishing goals of care are necessary in order to maximize outcomes and avoid inefficiency and miscommunication. Team members should have defined roles and responsibilities within the comprehensive AF program. Preestablished workflows and order sets can allow for standardization of care across providers in the hospital and clinic setting. All management is influenced by patient-specific factors and preferences. Management

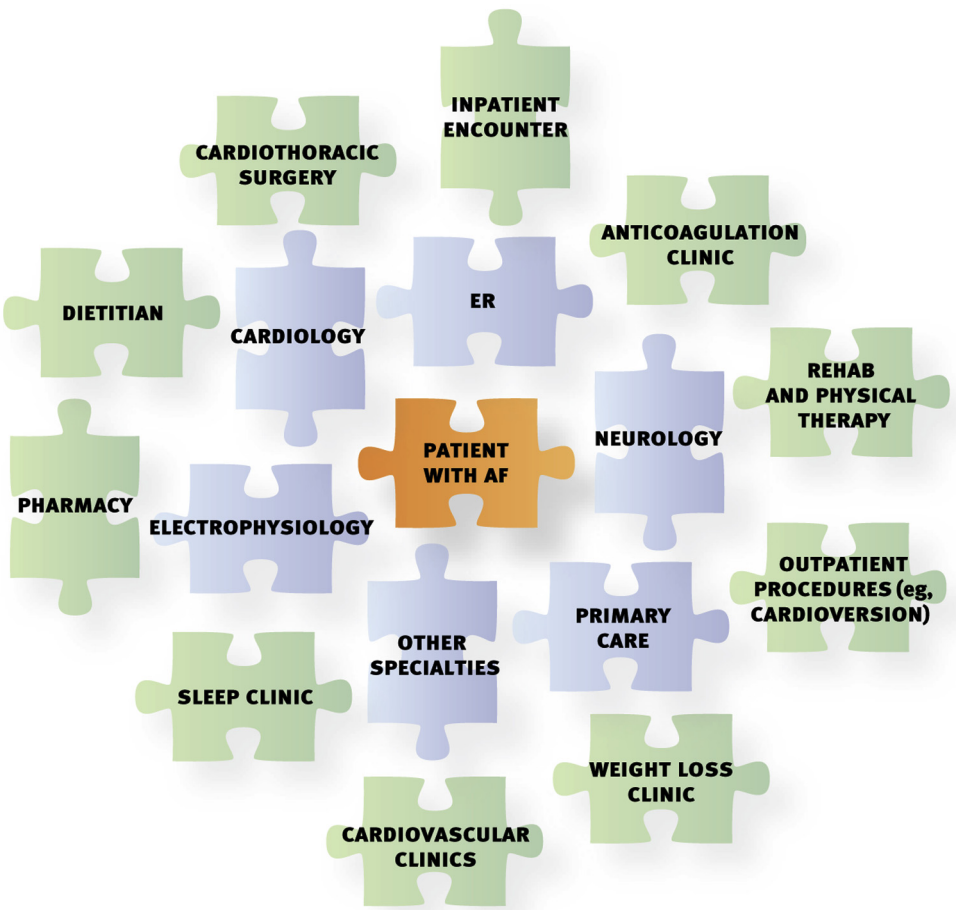

Figure 1 The complexity of the atrial fibrillation (AF) patient experience. ER = emergency room; REHAB = rehabilitation.

pathways for stroke risk assessment and treatment, rate control, perioperative anticoagulation bridging, weight loss, treatment of sleep apnea, antiarrhythmic drug initiation, and catheter ablation are just a few examples of care pathways that may be beneficial in the standardization of care for patients with AF. Open lines of communication also are required. Patient care information needs to flow seamlessly and bidirectionally between emergency room/hospital, AF clinic, cardiology office, and primary care. A well-integrated electronic medical record (EMR) can be an engine for team coordination and facilitate team-based care standardization. While the EMR can facilitate access to information, standardization of clinical AF data and reporting would help facilitate coordination of care, particularly between health care systems. AF care coordinators can also help facilitate communication and coordination of care.

Administrative support is critically important to ensure that adequate resources are available for development of an AF program. It is also the most important rate-limiting step in most institutions. Necessary resources include provision of staffing, dedicated clinic space, database and registries to track guideline adherence and outcomes, and team coordination. Data from many AF centers have shown that reductions in AF-related admissions, reductions in cardiovascular events, and improvements in patient satisfaction more than justify the operational expenses inherent to an integrated AF program (Table 1). Since most health care systems have resource limitations, initial efforts in a CoE may focus on important gaps and interventions that are less resource intensive.

Specific treatment goals

As previously noted, comprehensive AF care centers focus on the four pillars or management goals of AF, including risk factor management, stroke prevention, rate control, and rhythm control. While a review of the principles and evidence for AF management is beyond the scope of this statement, there are several ways in which AF CoEs can facilitate several specific aspects of AF care. In the following section, we will highlight some of these important opportunities.

Evaluating and improving symptoms

Patients with AF can experience a myriad of symptoms, including but not limited to palpitations, dyspnea, chest pain, fatigue and lethargy, exercise intolerance, difficulty in sleeping, and psychosocial distress, resulting in an impaired QoL.[23,55–58] AF CoEs can help improve care by consistently and systematically evaluating patient symptoms and tracking them over time to assess patient response to therapies. Systematic electronic capture of patient-reported outcome measures has been shown to be feasible and provides actionable clinical data.[58,59]

Rate and rhythm control

Rate control is a central part of AF management, even for patients who ultimately elect rhythm control. A rate control strategy may be sufficient to improve AF-related symptoms and QoL in some patients, especially elderly AF patients and those with minimal to mild symptoms or those who are asymptomatic. Because there is limited evidence to inform the optimal method and intensity of rate control, particularly with aging and with comorbid diseases,[60,61] decisions for treatment strategy should always be informed by shared decision-making (SDM). CoEs should have standard methods to ascertain the quality of rate control in order to reduce the risk of cardiomyopathy and heart failure. AF CoEs can help facilitate timely and systematic assessment of rate control through centralized review of data from wearable technologies and telehealth approaches.

AF centers also have opportunities to improve the quality of rhythm management. The major indication for rhythm control is to improve QoL in patients who are symptomatic with AF. Therefore, the most important criterion for patient selection is the presence of symptoms or cardiovascular dysfunction related to AF. Determining which symptoms are due to AF, the medications used to treat AF, or non-AF comorbid illness can be challenging. Systematic and serial assessment of QoL and symptoms are important when considering responses to treatment (including after cardioversion) and determining when it is time to consider switching to a new rhythm control intervention. Again, systematic collection of patient reported outcomes (PRO) data can facilitate management.[59,62,63]

Patient selection is a key step in catheter ablation and represents a core competency for CoEs. Most guidelines suggest that ablation should be second line to antiarrhythmic treatment (class I or III drugs).[27,64] Moreover, ablation also should be considered in patients with cardiomyopathy, tachy-brady syndrome where ablation of AF could prevent conversion pauses and avoid a pacemaker, patients <60 years old where long-term AF or exposure to antiarrhythmic drugs could be deleterious, or patients with professions that require no AF (eg, pilots, athletes). First-line therapy might also be considered in other patients who prefer to avoid medical therapy. The Catheter Ablation vs Antiarrhythmic Drug Therapy for Atrial Fibrillation (CABANA) trial recently reported a reduction in hospitalization and improved QoL for patients randomized to ablation in the intention-to-treat analysis.[65,66]

Proper counseling of the risks and benefits, including the likelihood of significant recurrence, are essential in any discussion of catheter ablation or surgical ablation. AF centers should record, track, and share their outcomes (both efficacy and safety) with their patients. AF centers should meet and ideally exceed accepted standards of care for catheter ablation. There are several AF ablation registries throughout the world that can facilitate outcomes tracking and reporting. HRS developed a National Quality Forum–endorsed performance measure regarding rates of pericardial tamponade complicating AF ablation. AF CoEs that perform ablation should have adequate procedural volume to optimize outcomes for catheter ablation.

Table 1 Evidence for integrated and multispecialty atrial fibrillation (AF) care teams

Study	Design	Intervention group	Comparator	Primary endpoint
Hendriks et al 2012[52]	RCT: 712 pts, 67y, 41% female; mean FU 22 months; single center; outpatient department new-onset AF pts	Nurse-led care with guideline-based, software-supported, integrated care supervised by cardiologist: integrated comprehensive care	Usual care	Composite of CV hosp. and CV death 14.3% vs 20.8% (nurse-led vs usual care), HR 0.65 (95% CI 0.45–0.93); $P = 0.017$. CV death in 1.1% vs 3.9%, 0.28 (0.09–0.85); $P = 0.025$. CV hosp. 13.5% vs 19.1%, 0.66 (0.46–0.96); $P = 0.029$
Stewart et al 2015[95] (SAFETY)	RCT: 335 pts, 72y, 48% female; mean FU 30 months; multicenter; pts hospitalized for AF	Home visit and Holter monitoring 7–14 days after discharge by nurse with prolonged FU and multidisciplinary support as needed: comprehensive care	Usual care	ACM and all-cause hosp. 76% vs 82% (intervention vs usual care), HR 0.97 (95% CI 0.76–1.23); $P = 0.85$
Carter et al 2016[96]	Before and after study: 433 pts, 64y, 44% female; FU >12 months; multicenter; new-onset AF ED pts	After phase is nurse-run, supervised by physician AF clinic with group education: comprehensive care	Usual-care 2009–2011 is before phase retrospective	Composite death, CV hosp., AF ED visits, propensity matched: 17.3% vs 26.2% (intervention vs usual care) (OR 0.71, 95% CI 0.59–0.99; $P = 0.049$); ED visits 13.1% vs 20.8% ($P = 0.06$); hosp. 6% vs 9.5% (OR 0.60, 95% CI 0.27–1.37; $P = 0.22$); OAC 88.4% vs 58.5% ($P < 0.01$)
Vinereanu et al 2017[49] (IMPACT-AF)	Cluster RCT: 2281 pts, 70y, 47% female; FU 12 months; multicenter	Patient and HCP education, regular monitoring, and feedback to HCPs: focus only on antithrombotic therapy	Usual care	Change in % pts on OAC at 1 year: intervention, 68% to 80%; usual care, 64% to 67%; OR 3.28 (95% CI 1.67–6.44) of change in OAC use between groups
Gallagher et al 2017[94]	Systematic review and meta-analysis: 1383 pts			Reduction in ACM (OR 0.51, 95% CI 0.32–0.80; $P = 0.003$) and CV hosp. (0.58, 0.44–0.77; $P = 0.0002$); no impact on AF hosp. (0.82, 0.56–1.19; $P = 0.29$) or cerebrovascular events (1.00, 0.48–2.09; $P = 1.00$)
Cox et al 2018[104] (IMPACT-AF) LBCT at AHA 2018 submitted	Cluster RCT: 1145 pts, 72y, 40% female; FU 12 months; primary care pts; data presented at AHA 2018	CDSS, incorporating guideline-based physician monitoring system proactively and assisting physicians by providing therapeutic recommendations: comprehensive care	Usual care	Composite of AF-related ED visits or unplanned CV hosp., HR 1.02 (95% CI 0.73–1.41); $P = 0.93$, and ISTH major bleeding, 1.04 (0.38–2.88); $P = 0.93$
Rienstra et al 2018[105] (RACE 3)	RCT: 245 pts, 64y, 21% female; FU 12 months; multicenter; early persistent AF and mild-to-moderate heart failure pts	Four risk factor therapies: 1) mineralocorticoid receptor antagonists, 2) statins, 3) angiotensin-converting enzyme inhibitors and/or receptor blockers, and 4) CR including physical activity, dietary restrictions, and counseling: comprehensive care	Usual care	Sinus rhythm at 1 year during 7 days of Holter monitoring: sinus rhythm present in 75% of patients in intervention vs 63% in conventional group (OR 1.765, lower limit of 95% CI 1.021; $P = 0.042$)

(*Continued*)

Table 1 (*Continued*)

Study	Design	Intervention group	Comparator	Primary endpoint
Parkash et al 2017[106] (SMAC-AF)	RCT: 184 pts, 60y, 25% female; FU 14 months; multicenter; pts with AAF and BP >130/80 mm Hg	Aggressive BP (target <120/80 mm Hg) treatment: focus only on BP management	Standard BP (target <140/90 mm Hg) treatment	Symptomatic recurrence of AF/AFL/AT >30 seconds 3 months beyond catheter ablation: 61.4% in aggressive BP vs 61.2% in standard (HR 0.94, 95% CI 0.65–1.38; P = 0.763)
Alharbi et al 2019[107]	CR (133 pts) compared with specialized AFC (197 pts) and usual care (236 pts): mean age n.a., 40% female; FU 12 months	CR, medically supervised, involving prescribed exercise, cardiac risk factors modification, education, and counseling: comprehensive care	Usual care retrospective	AF-related ED visits and CV hosp.: 7.5% in CR, 16.8% in AFC, and 29.2% in usual care group. Propensity-matched analysis: CR best compared with usual care OR 4.91 (95% CI 2.09–11.53) and compared with AFC 2.75 (1.14–6.6)
Hendriks et al 2019[108]	RCT: 712 pts, 67y, 41% female; mean FU 22 months; single center, outpatient department new-onset AF pts; post hoc analysis	Nurse-led care with guideline-based, software supported integrated care supervised by cardiologist: integrated comprehensive care	Usual care	ACM 3.7% vs 8.1% in nurse-led vs usual care (HR 0.44, 95% CI 0.23–0.85; P = 0.014); CV mortality in 1.1% vs 3.9% (0.28, 0.09–0.85; P = 0.025); non-CV mortality 2.5% vs 4.2% (0.59, 0.26–1.34; P = 0.206)
Wijtvliet et al 2019[109] (RACE 4)	RCT: 1354 pts; FU 37 months	Nurse-led comprehensive care by specialized nurses using a decision support tool, in consultation with the cardiologist	Usual care	

AAF = acute atrial fibrillation; ACM = all-cause mortality; AFC = AF clinic; AFL = atrial flutter; AHA 2018 = 2018 American Heart Association Scientific Sessions; AT = atrial tachycardia; BP = blood pressure; CDSS = clinical decision support system; CI = confidence interval; CR = cardiac rehabilitation; CV = cardiovascular; ED = emergency department; FU = follow-up; HCP = health care provider; hosp. = hospitalization; HR = hazard ratio; IMPACT-AF = Integrated Management Program Advancing Community Treatment of Atrial Fibrillation; ISTH = International Society on Thrombosis and Haemostasis; LBCT = late-breaking clinical trial; n.a. = not available; OAC = oral anticoagulation; OR = odds ratio; pts = patients; RACE = Rate Control versus Electrical Cardioversion; RCT = randomized controlled trial; SAFETY = Standard vs Atrial Fibrillation Specific Management Study; SMAC-AF = Substrate Modification With Aggressive Blood Pressure Control; y = years of age.

Stroke prevention

Prescribing OAC to reduce the risk of stroke and systemic embolism, while minimizing the risk of bleeding, is a critical component in the treatment of patients with AF and a core competency for any AF CoE. Centralized approaches to implement, guide, and monitor OAC have been shown to be highly effective. Systematic evaluation of electronic health record (EHR) data to assess whether eligible patients are receiving appropriate stroke prevention therapy represents another opportunity to improve care.[67,68] While many national and international observational analyses have documented the difficulty in achieving high rates of OAC utilization, quality improvement programs can be highly effective at improving OAC use[46,49] and can be easily implemented in AF centers.

However, not all patients can tolerate long-term OAC for stroke prevention. Therefore, consistent with the aggregate evidence, guidelines recommend that left atrial appendage (LAA) occlusion may be considered in patients with AF at increased risk of stroke who have contraindications to long-term anticoagulation.[32] LAA occlusion may be percutaneous or performed through surgical isolation,[69,70] and AF CoEs can serve a critical role in improving the identification of patients who have difficulty with long-term OAC, ensuring proper patient education, and prioritizing SDM regarding treatment options. Engagement of other specialties, including but not limited to gastroenterology, neurology, surgery (AF surgery and LAA clipping), and primary care, is also critical to ensure comprehensive care. AF centers can also help ensure optimal outcomes after LAA occlusion by facilitating timely post-procedure follow-up and imaging and appropriate transitions in medical therapy (eg, transitioning from OAC to dual antiplatelet therapy or from dual antiplatelet therapy to aspirin monotherapy).

Treatment of risk factors

As previously noted in Section 2, AF frequently coexists with many cardiovascular and noncardiovascular comorbidities that are potent risk factors for the development and progression of AF. Therefore, the identification and treatment of these conditions through a holistic, integrated, patient-centered approach is essential to achieve the best possible outcomes for patients with AF.[70–72] Despite prospective studies that highlight the importance of risk factor and comorbidity management, in clinical practice, fewer than half of patients with AF are adequately treated for their comorbid illness and risk factors.[73] Addressing risk factors such as obesity, diabetes, hypertension, sleep apnea, and others are a critical function of any CoE.[71,74]

Integration of CIED care, monitoring, and wearables

Some patients treated for AF will have CIEDs, many of which are capable of continuous AF detection with high accuracy. As such, these patients will have an accurate assessment of AF burden. Continuous measurement of AF burden has many advantages in the management of AF, and an increasing number of studies have shown that AF burden has important implications for symptoms and functional status.[75–77] Even in patients who receive rate control only, continuous monitoring can provide a more accurate assessment of optimal rate control compared with intermittent monitoring.[78] Beyond patients with known AF, improving time from AF detection to therapy with the use of implanted loop monitoring may also improve outcomes in patients with prior cryptogenic stroke.[10] Thus, there are many advantages to ensuring that CIED care is integrated with AF care.

Similarly, many patients with AF undergo ambulatory monitoring. Beyond formal ambulatory monitoring, more and more patients utilize direct-to-consumer wearable technology. While this aspect of heart rhythm care continues to evolve in a rapid fashion, coordination, clinical resource management, and optimal utilization of these data to improve care also should be a goal of AF CoEs.

Development of team-based care pathways

Management of AF according to evidence-based guidelines is recommended in order to improve outcomes. AF CoEs should hold clinicians accountable to guideline-recommended care while acknowledging the primary goals of patient-centered and individualized care. Unfortunately, guideline-adherent therapy in daily clinical practice is poor and represents a significant opportunity to improve care.[79]

There are several reasons for suboptimal adoption of guideline recommendations for AF treatment. First, AF is a very complex disease with significant heterogeneity among patients. Second, AF care is often fragmented, being performed by different health care providers without adequate and/or frequent communication. Third, routine coordination of patient management with care coordinators (similar to those used in transplant clinics) is uncommon. Fourth, there are shortcomings in provider and patient education.[49,80,81] Finally, there is a lack of evidence-based clinical decision support systems to improve guideline-adherent therapy, enhance education, improve communication between patients and clinicians, and encourage active patient involvement in AF management.[82] For all of these reasons, the development of team-based pathways and protocols based upon best clinical practice and guideline-directed care is needed to achieve better outcomes for patients with AF.

Section 4 Team-based integrated care

The optimal evaluation and management of patients with AF requires the best possible management of comorbidities, risk factors, and lifestyle modification. These typically fall well outside of the boundaries of the expertise of arrhythmia centers and require a patient-centered multidisciplinary team approach. As detailed in Section 3, an integrated team-based approach is a core component of an AF CoE. Coordination of care between different health care professionals is difficult, but its importance cannot be overstated.

Integrated, team-based care should be timely and well coordinated. From a clinician's perspective, navigating an individual patient through the complex and often inefficient environment of multidisciplinary care is daunting. Ideally, a patient navigator would coordinate these services. Patient navigators are health care professionals who focus on the patient experience and organization and successful matriculation of an individual patient's care. In reality, few if any health care delivery systems provide financial reimbursement for care coordination or many of the lifestyle modifications known to be effective in improving outcomes for patients with AF.

International AF guidelines recommend a multidisciplinary team approach to address patient education regarding general AF knowledge, symptom management, aggressive treatment of modifiable risk factors, stroke prevention, patient-centered decision-making, and improved adherence to treatment guidelines.[5,83] Use of multidisciplinary teams has demonstrated improved patient outcomes in other medical fields, including but not limited to oncology,[84,85] heart failure,[86–88] stroke,[89,90] diabetes and chronic disease,[91] and heart transplantation.[92,93]

Use of a multidisciplinary team-based approach with AF patients has been associated with improved outcomes such as a 49% reduction in all-cause mortality,[52,94,95] 42% reduction in cardiovascular hospitalizations,[52,94–96] 50%–82% reduction in emergency department visits,[96,97] significantly shorter wait times to see an electrophysiologist,[96,97] more cost-effective care,[98,99] and fewer readmissions and shorter length of hospital stay.[95,100] Although the exact composition of the teams varied between studies, core components included an electrophysiologist, general cardiologist, sleep apnea and/or anticoagulation/stroke specialist, clinical pharmacists, and an AF nurse specialist or advanced practitioner, with other specialists invited as needed.[101,102]

Table 1 summarizes the available evidence for integrated, multidisciplinary AF care clinics. While early experience with integrated management of AF has been positive, there is still a significant need for validation across different health care systems. There is a lack of a uniform definition of integrated care, and there are a limited number of randomized trials as well as significant differences in the operational aspects of the AF centers.

The early published experience detailed in Table 1 provides an operational framework for what might work best in an AF CoE. As illustrated in Figure 2, this operational framework includes a core group of individuals to coordinate the integrated care. The framework must also ensure access to appropriate subspecialty care and involve the participation of allied health care professionals to provide comprehensive management. Integration between outpatient and inpatient care environments allows easy access to information and plans of care, facilitated by an electronic system.

A major challenge to widespread global implementation is the difficulty in scaling specialty care using a traditional in-person clinic approach only. Technology-enabled solutions have promise in AF care delivery using several frameworks: 1) patients may directly receive remote care from AF centers using video-to-home visits; 2) front-line clinicians, including primary care clinicians, could receive remote consultative guidance and education from designated AF centers; and 3) free-standing remote telehealth services could also provide

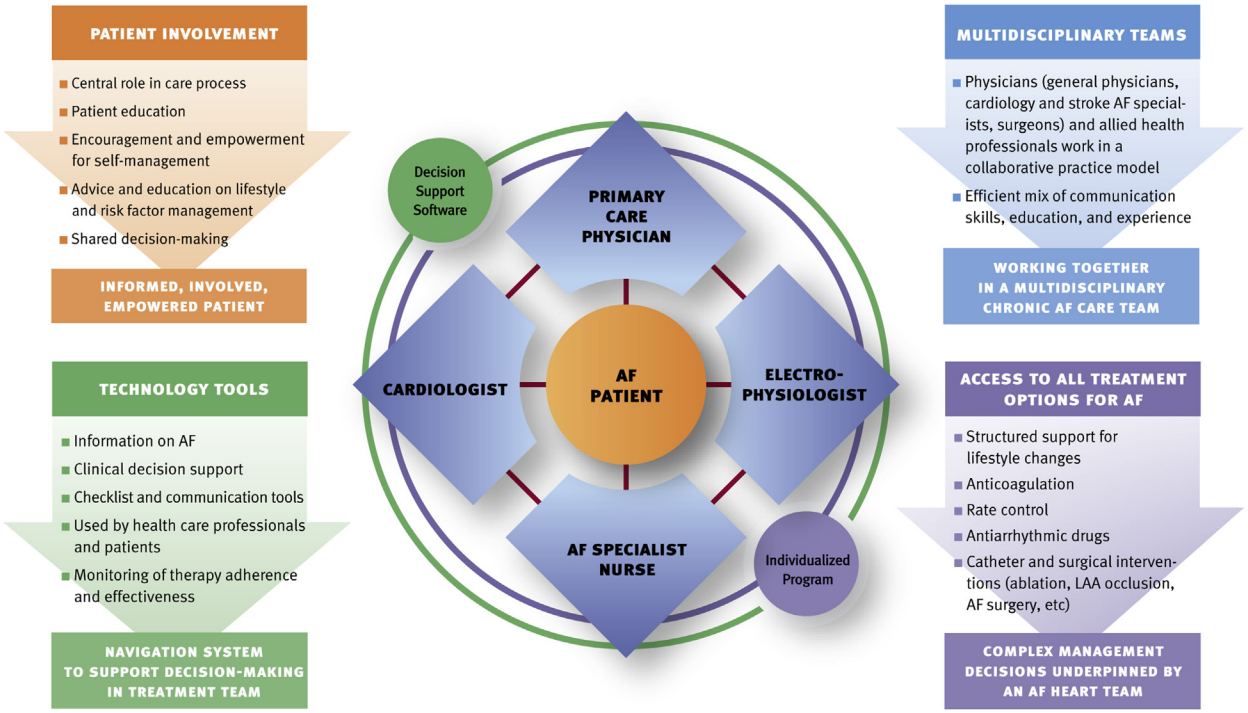

Figure 2 Fundamentals of team-based integrated care models in atrial fibrillation (AF). LAA = left atrial appendage.

some aspects of care. In the Apple Heart Study, which enrolled 419,000 participants from all 50 states in the United States in order to assess a smartwatch pulse-based AF detection algorithm, participants with an irregular rhythm notification were referred for local care.[103]

These types of approaches may also be useful in resource-rich areas by increasing efficiency and value, ultimately affording guideline-driven, high-quality AF care at lower cost. However, it is also important to note that use of remote telemedicine services outside of traditional health care systems carries challenges, including quality assurance and disruptions in continuity of care. Progress with these technologies will require attention and solutions for these challenges. AF CoEs should also develop systems, including organized patient portals and software platforms, to deal with the increasing volume of patient-directed wearable-based monitoring, as these monitoring technologies are becoming more frequent and more important in AF management.

Finally, there are often several difficult operational challenges that arise in the provision of multidisciplinary care for AF. For example, arranging safe and timely cardioversion is often a challenging task for clinicians, especially when there is need for transesophageal echocardiography and advanced anesthesia. Other operational challenges include, but are not limited to, timely evaluation and treatment of sleep apnea, lack of reimbursement for cardiac rehabilitation for AF patients in many parts of the world, and lack of adequate nutritional counseling and weight loss clinic services. Development of clinical and operational pathways is an opportunity to improve both the efficiency and quality of care in AF CoEs.

Section 5 Quality improvement

Quality improvement (QI) is an important component of state-of-the-art AF care. Consistent with the breadth of AF care, AF-related QI may address a wide variety of interventions (eg, stroke prevention, reduction in complications after ablation, etc). Ultimately, QI efforts should provide evidence that quality interventions improve patient outcomes in individual centers and in the general population. Different approaches are possible and may seek to identify best medical practice, improve guideline adherence, or streamline care. Alternatively, QI may help benchmark the "standard of care" and measure quality of care. A specified multidisciplinary committee at each institution should be involved in this complex task and should be a core component of any AF CoE.

Importance of measuring performance and quality improvement

QI is the framework we use to systematically improve the ways care is delivered to patients.[110] Toward the goal of improving care, Berwick and colleagues[111] identified a "Triple Aim" of "care, health, and costs" that can be measured. Why are quality measurement and QI important? Although randomized trials and clinical guidelines provide evidence-based diagnostic and treatment strategies, unless these interventions are implemented systematically, gaps in care can and will occur. In AF, for example, despite clear evidence that OAC reduces stroke risk, when measured systematically in a large outpatient clinic-based registry, nearly half of ambulatory cardiology practice patients with a CHA_2DS_2-VASc score of 4 or greater were not being treated with guideline-directed therapy.[112]

Ultimately, improving the quality of care that is delivered requires some measurement of the processes, outcomes, costs, or patient experiences that are delivered, including application of current guideline recommendations. These measurements can be made through a variety of mechanisms, including individual data collection processes by a single provider or practice, implementation of standardized performance measures, or enrollment in clinical quality registries.

Whereas measuring outcomes after AF interventions is one important component of QI in AF care, some experts have advocated mandatory minimum numbers for invasive procedures (eg, catheter ablation or appendage occlusion) in order to optimize quality. These minimum volume standards are relatively easy to implement and track over time.[113] There is a positive correlation between case volume and treatment results and an inverse correlation with complication rates.[114] However, many questions regarding minimum volume requirements remain unanswered, including the optimum cutoff, the lack of scientific data for any clear value for cutoffs, and whether volume requirements should be per center or per operator.

Protocols for standardized practice

Protocols for standardized practice are an important component of quality-based care. A good example of an opportunity for improvement is in the evaluation and management of CIED-detected AF, where practice variation is considerable. In the treatment of AF, standardized operating procedures may differ across health care facilities depending on the availability of different diagnostic and therapeutic capabilities. Standardization of specific procedures may be easier to establish and operationalize than that of diagnostic or evaluation strategies. While often controversial, benchmarking is an important step in establishing standardized practice. In addition to institutional committees, an international committee to discuss, establish, and evaluate protocols for best practice could be convened by HRS in partnership with other international electrophysiology societies. This could also be supported by convening a group of international experts to create a consensus document. HRS has already done this with respect to electrophysiology laboratory standards,[115] but standards specific to AF CoEs may also be beneficial.

In the treatment of AF, we are fortunate to have a large number of studies that identify the best treatments. Guidelines have been developed that assess and translate this medical knowledge into recommendations for physicians to apply. The problem of limited guideline adherence does not seem to be due to a knowledge gap, nor is it unique to

electrophysiology. In general, physicians know the guidelines. In the National Cholesterol Education Program, 95% of physicians were aware of the guidelines, but only 18% of patients were treated to goal.[116] Certainly, education is a critical part of guideline adherence, but it is only one part.

There are a large number of national and international AF registries that have examined quality of care. While recording data in registries does improve adherence, it appears to have a modest effect. Thus, a distinction must be made between a passive recording of information in a registry versus an active and comprehensive QI program. While there are many examples of the latter, the American Heart Association, in partnership with HRS, developed Get With The Guidelines-AFIB (GWTG-AFIB), a national, hospital-based quality improvement program that uses multidisciplinary teams, order sets, educational programs, a web-based patient management tool, and benchmarking to provide feedback. The program also uses performance achievement awards for recognition of high-performing hospitals. For example, sites with ≥85% adherence with the achievement measures for 24 consecutive months are awarded "Gold" status.[117] In the GWTG-AFIB program, 96.6% of eligible patients received this therapy.[46] Overall, improving adherence to guidelines is complicated in health care systems. It involves not only physician knowledge of the guidelines but also a medical team and institutional commitment of resources and energy for success.

Achieving stakeholder consensus on specific goals and metrics of care

AF management guidelines speak uniformly that a collaborative approach to AF is optimal for best practice. Additionally, because patients with AF have multiple touch points across the health care continuum, creating synergy between each of the stakeholders is essential. Developing an AF CoE requires engagement and support ("buy-in") from clinicians, health care systems, accountable care organizations, and payers. Unfortunately, there are often competing interests among these stakeholders, and this is especially the case in the fee-for-service model in the United States. Agreement by stakeholders on specific goals, timelines, and components for metrics of care is essential. The opportunity to objectively look at how patients with AF are managed across the health care systems can often provide a pathway to collaboration by identifying areas of improvement. When creating metrics, it is important to ensure that all stakeholders and AF care team members have a voice in the decision-making process.

Establishment of processes to improve care

Continuous quality improvement (CQI) subscribes to the idea that opportunities for improvement exist in every process and occasion.[118] Collecting baseline data, which can be accomplished using established registries, is an important first step in this process. QI methodologies commonly used in health care to design and implement changes include plan-do-study-act, six-sigma, lean, and most recently lean-six-sigma strategies.[119] Such methodologies may be used to improve performance, quality, and patient outcomes (such as adherence to guidelines). They include an initial analysis and implementation phase, followed by redesign of the process based on lessons learned. High-functioning systems will continuously analyze the effectiveness of their interventions and quickly react and make necessary changes to meet goals.

Failure to meet the set goals can be secondary to personnel, system, and external factors.[120] Barriers to implementation and adherence need to be analyzed in advance so that strategies that are tailored to the specific setting and target groups can be developed. Finally, the careful planning necessary to a successful QI project is best done by a committee that meets regularly to review performance data and monitor improvement efforts. To be effective, the team should include individuals representing all areas of the practice that will be affected by the proposed QI projects. CQI is a key mechanism through which AF CoEs can ensure success in both the short term and long term.

Section 6 Focus on patient-centered care

Patient engagement and empowerment are crucial to the successful management of AF. Adequate education of patients and their families is required for them to actively engage in their care. Engaged patients have better outcomes, reduced health care costs, and better patient experiences.[121] Patient organization and advocacy groups, such as StopAfib.org and the Arrhythmia Alliance, can also play an important role in supporting patient-centered care.

Shared decision-making

SDM is one of many tools that facilitate patient engagement and empower patients to become active participants in their care. SDM involves an interactive exchange of information between clinicians and patients. This patient-centered decision-making process allows clinicians to illustrate possible treatment choices and patients to share their individual values, expectations, and preferences about the treatment options in order to make informed choices about their care.[122–125] Given the variety of treatment options, SDM has become an important part of AF care.

Ideally, SDM is not one conversation but an iterative process that occurs over time as the clinician-patient relationship develops and the patient's disease trajectory necessitates a change in the treatment plan. Decision aids such as videos, brochures, pictographs, interactive electronic presentations, or smartphone applications have been reported to improve patient knowledge, engagement, and satisfaction; decrease decisional conflict; and increase patient participation in care.[126–128] Fortunately, there are a large number of excellent resources for development and evaluation of decision aids for patients with AF, and there are more in development.[129–131] SDM conversations are crucial to incorporate the patient's perspective in selection of stroke prevention treatment and are sometimes required by payers,

as in the case of LAA occlusion. Often, AF patients are unaware of the high stroke risk that AF entails and have inadequate understanding of their disease and/or medical treatments, which leads to poor adherence with OACs.[132–134] Patient preferences for antiarrhythmic drug treatment, catheter ablation, or rate control versus rhythm control drug strategies are important to incorporate into treatment plans as well. Future studies on the relationship between patient engagement, SDM, and patient adherence to AF therapies are needed. Fortunately, there are ongoing clinical trials focused on SDM for stroke prevention including Shared Decision Making for Stroke Prevention in Atrial Fibrillation (SDM4Afib) (NCT02905032) and Shared Decision-Making: AFib 2gether Mobile App (Afib2-gether) (NCT04118270). The results of these trials may help inform efforts to standardize SDM and improve quality.

Patient-reported outcomes

There is increasing recognition of the importance of including patient-reported outcomes (PROs) when assessing the impact of a treatment strategy on chronic, nonfatal conditions.[135] There are several PRO instruments that can be used to evaluate AF, including but not limited to the Atrial Fibrillation Effect on QualiTy-of-life (AFEQT), University of Toronto Atrial Fibrillation Severity Scale (AFSS), and Mayo AF-Specific Symptom Inventory (MAFSI) tools. Detailed guidance on how to incorporate PROs in clinical trials has recently been published.[136] Despite this appreciation, between 1999 and 2018, only 14% of AF clinical trials registered at ClinicalTrials.gov reported collecting PROs.[135] Furthermore, among the trials that did include PROs, only 17% used a published AF-specific tool despite evidence demonstrating that AF-specific tools are superior to general assessments in the evaluation of AF-related QoL.[137] PROs offer an opportunity to provide meaningful, patient-centered assessment of patients' perceived benefit from AF interventions. Standard recommendations can be incorporated into routine activities of an AF center.[138]

Patient engagement

SDM and PROs are helpful in maintaining patient engagement. Higher levels of patient engagement in decision-making and symptom management, higher levels of AF knowledge, caregiver support, reminders and routines for pill taking, use of technology, and nurse-led clinics have been associated with better adherence and more positive clinical outcomes. Patient activation for self-management is associated with improved health status in patients with AF.[134,139–142] Compliance with medical treatment, lifestyle modification, and follow-up visits are essential in order to achieve desired patient outcomes.

There are many factors that influence patient's adherence to care. Frailty, increased age, cognitive dysfunction, vision impairment, and depression have been demonstrated to be barriers to OAC adherence.[140] Sex, racial, cultural, and socioeconomic differences also impact adherence. It is also important to note that a key impediment to optimal adherence is lack of effective communication between clinicians and patients. Interventions need to be developed to support patients most at risk for poor adherence. AF centers should be designed with these barriers in mind to ensure optimal adherence and improve outcomes. In other words, high-quality patient communication and patient education need to be core competencies for any AF center.

Equity in AF care

High-quality health care should be equitable.[143] In this framework, AF centers should provide care for all patients with AF without discrimination based on age, sex, gender identity, race/ethnicity, education, religion, sexual orientation, socioeconomic status, or other determinants. Unfortunately, disparities in health care delivery based on factors such as these are all too common.[144] For example, African American and Hispanic patients are less likely to undergo AF ablation.[145] Comprehensive AF centers should champion approaches that maximize both access to care and the delivery of high-quality care to all patients with AF. Identification of patients with AF is only the first step in ensuring high-quality care. Once patients with AF are identified, ensuring equal access to AF care is of paramount importance.

Section 7 Efficiency and financial considerations

Opportunities for innovation while improving efficiency

AF is a costly public health problem for several reasons, but high rates of hospitalization are a particularly important driver of costs in AF care. The care of patients with AF is complex, and improving outcomes requires careful coordination of outpatient, emergency, inpatient, and procedural care. An AF CoE should focus on all these areas while considering the local needs, resources, and available clinicians. Many electrophysiology groups have led the way and used innovative approaches to deliver cost-effective, efficient care while attempting to improve quality and outcomes. Examples include multidisciplinary AF centers,[96] electrophysiology laboratory efficiency programs, inpatient and outpatient QI programs, and, more recently, interventions that leverage digital health.

While an integrated approach to the care of the AF patient has intuitive appeal, the evidence to support the favorable impact on patient outcomes remains limited (Table 1). A recent meta-analysis (n = 3 studies with a total of 1383 patients) demonstrated an association with lower all-cause mortality and cardiovascular hospitalizations but did not significantly impact AF-related hospitalizations or cerebrovascular events.[94] The number needed to treat in an integrated AF clinic to prevent 1 cardiovascular hospitalization and 1 death was 18 and 19, respectively. This appears to compare favorably to a number needed to treat of 11 and 17 to prevent 1 cardiovascular hospitalization and 1 death in a heart failure clinic.[88]

The number of AF ablations performed yearly in the United States continues to rise. Innovations that improve efficacy, safety, and efficiency of ablation procedures are welcome. Procedural times have shortened in part due to the evolution of electroanatomical mapping and ablation technologies as well as operator experience, but other aspects of ablation care could be optimized in order to achieve additional and significant gains in efficiency. In general, efficiency and outcomes in electrophysiology laboratories can be improved with systematic implementation of QI programs.[119] These methods use standardization and reduction of waste. Although not new, use of these programs in electrophysiology laboratories is still limited, although it is becoming more common. As health care delivery changes, AF management poses unique challenges, and there are many opportunities to innovate and improve the delivery and quality of care.

Reimbursement

Health care payment models worldwide are in a transition toward value-based reimbursement. In an effort to respond to unsustainable growth in costs, the Medicare Access and Children's Health Insurance Program (CHIP) Reauthorization Act (MACRA) was passed by Congress in 2015.[146] This act established the Quality Payment Program (QPP) that introduced value-based reimbursement models to determine how the Centers for Medicare & Medicaid Services would reimburse physicians. Central to this act are core measurements such as PROs and functional status, patient experience measurements, care coordination measurements, and assessment of appropriate use.

In 2018, HRS convened a working group to evaluate arrhythmia-based care in an evolving value-based reimbursement environment.[147] The consensus evaluation was that alternative payment models for reimbursement were unlikely to succeed for AF ablation for two primary reasons. First, there is marked variability of AF management beyond the control of an electrophysiologist, and second, it can be difficult to assign a specific value to the benefits of ablation (such as improved QoL and a reduced arrhythmia burden). In the Merit-based Incentive Payment System (MIPS), an easily identified metric of procedural safety was advocated as an outcome measure: cardiac tamponade and/or pericardiocentesis following AF ablation.

The concept of value-based reimbursement will remain central as AF represents the most commonly encountered sustained clinical arrhythmia. Within the Medicare program (2013–2014), estimated AF-related outpatient costs were $1.28 billion, and the AF-related physician costs were $102.4 million. Among the population treated with AF ablation, $245.6 million and $2.72 million dollars of hospital and physician costs were reported, respectively.[147]

In the case of AF ablation, there are a number of areas in which care can be standardized and improved to align with value-based care metrics and lower costs. First, real-world outcomes remain less than ideal, but there is a measurable cost savings observed over time when AF ablation is successful.[148,149] The cost-effectiveness of AF ablation is less apparent in older patients where recurrence and complication rates are often higher. Second, there is a significant increase in costs with repeat ablation that emphasizes the need to improve procedural efficacy and patient selection.[150] Third, there are marked geographic variances in AF ablation that do not correlate with regional disease prevalence.[151] Finally, there is also significant variation in the facility costs associated with AF ablation (median: $25,100; 25th percentile: $18,900; 75th percentile: $35,600; 95th percentile: $57,800). This significant variation is related in part to differences in procedural techniques and equipment as well as to add-on billing.[152] Some variation in cost is attributable to physician factors, including choices of equipment that range from $6,637 to $22,284 per case. Finally, centers that have higher volumes experience better success rates and lower complication rates, both of which impact immediate and long-term costs in AF management. AF centers can address many of these areas with improved patient selection and higher institutional and physician volumes that improve procedural risks and benefits,[26] minimize procedural variability, and enable volume-based purchasing of tools and equipment at a discounted rate. Alignment between AF ablation centers can also minimize geographic variability.

Cost-effectiveness of AF centers

The AF center care model is focused on the longitudinal care of the patient with special emphasis on risk factor modification and timely treatment. This model has proven to be successful with outcomes including decreased health care utilization and decreased wait times for evaluation.[99] The financial impact of AF centers can be varied and determined by patient count and demographics, local health care system structure, and number of physicians. When evaluating the cost-effectiveness of AF centers, several factors should be considered, including but not limited to decreased health care utilization, including reduced emergency room visits and hospitalizations, and avoided complications such as strokes. Utilization of remote monitoring approaches may also help detect AF with rapid rates, and telephone contact with remote therapeutic recommendations, including medication titration, may reduce emergency room visits. As AF is a progressive disease,[153] early intervention with lifestyle modification education and treatment also has been shown to translate into cost savings by slowing disease progression.

Section 8 Accreditation and options for participation/scope

Accreditation is the process of recognizing an entity for their achievement of becoming qualified to perform an activity. While there are no formal accreditation options for AF centers at this time, there are accreditation options for certifications of electrophysiology laboratories. For example, Figure 3 illustrates the requirements for AF ablation centers in Germany. There are many reasons why an electrophysiology laboratory would seek one of the available

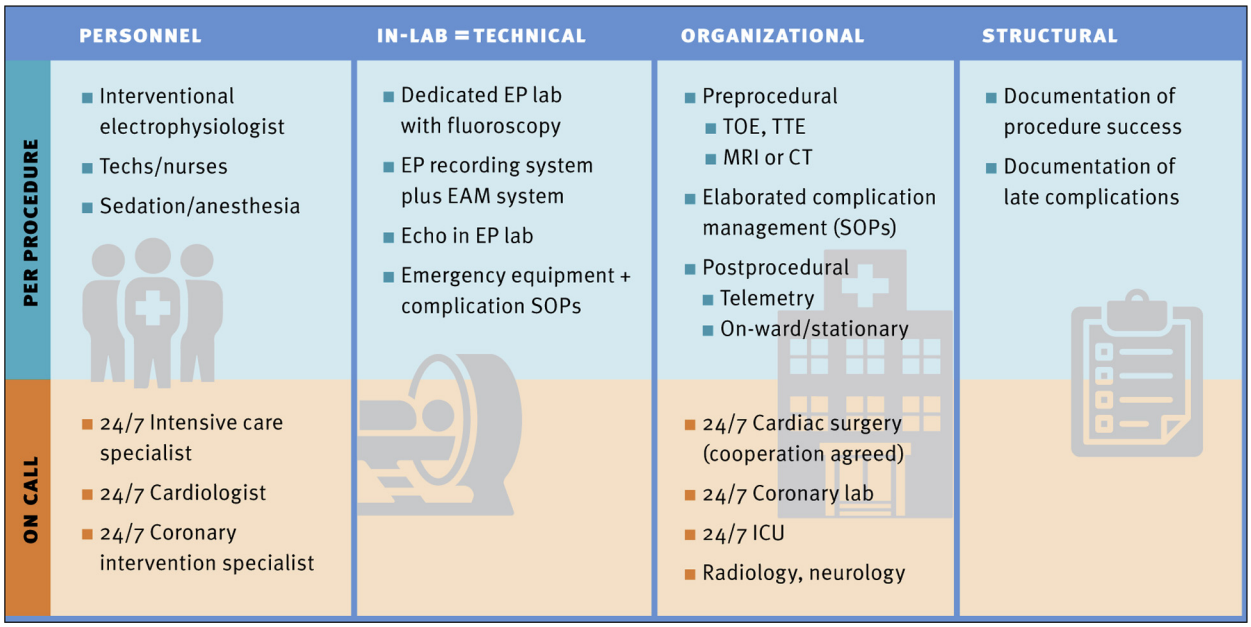

Figure 3 Certification process for atrial fibrillation centers in Germany including personnel, in-laboratory technical aspects, in-center organization, and structural requirements, including follow-up of patients and complication management. CT = computed tomography; EAM = electroanatomic mapping; Echo = echocardiography; EP = electrophysiology; ICU = intensive care unit; lab = laboratory; MRI = magnetic resonance imaging; SOPs = standard operating procedures; Techs = technicians; TOE = transesophageal echocardiogram; TTE = transthoracic echocardiogram.

accreditations. However, before an organization decides to become accredited, it must identify what value such an achievement brings.

A decision to become accredited may stem from a desire to improve quality. The accreditation process itself is a unique opportunity to elevate the care of an electrophysiology program. Accrediting bodies have criteria for achievement of this certification, and thus the process may identify aspects of care that need to be implemented or improved to achieve high-quality care. Accrediting agencies also may provide a method for data entry and benchmarking against other similar organizations, which can also lead to incremental improvement.

Another reason for centers to pursue accreditation may be that a governmental organization or a payer may require accreditation for regulation or reimbursement. For instance, accreditation by The Joint Commission is a requirement for participation in Medicare. Health care organizations may also desire accreditation as a "seal of approval." Achievement of such a "seal" can be motivating for organizations to improve the quality of care; however, there is no definitive evidence that accreditation improves patient satisfaction.[154] Despite the lack of prospective evidence demonstrating that accreditation improves patient satisfaction, establishment of AF CoEs may substantially improve patient experience.

As the field of electrophysiology has evolved, the volume and complexity of the procedures have increased, as has the complexity of disease management. In light of this increased complexity, it is important to have standards unique to heart rhythm medicine. Accreditation could provide a framework for institutions to benchmark themselves and initiate important QI programs that will drive the quality of care higher. This is particularly true in the case of AF centers. A key developmental step will be consensus on what resources, services, and performance metrics are inherent to an AF CoE. Moreover, accreditation should not be an all-or-none phenomena, as some AF CoEs may vary in the scope of services they provide. In other words, there should be different levels of AF CoE based upon the services a given health care system provides. For example, all AF centers should be able to provide guideline-directed care, but not all AF centers may offer catheter ablation, cardiothoracic surgical treatment of AF, or LAA occlusion. Potential domains for accreditation for an AF CoE are shown in Table 2.

Section 9 Goals, gaps in care, and challenges

Goals

As discussed in the previous section, there is no accepted definition or consensus-based standard to define an AF CoE. The goal of establishing a health care CoE is to standardize the care of patients with a certain condition(s), based on guideline-directed care, in order to achieve the best outcomes. The important benefits of creating AF CoEs are 1) to establish a pragmatic organizational framework for AF centers, 2) to implement the framework, and 3) to provide a structure for both maintenance and evolution of AF care.[155] The rationale for establishing AF CoEs are 1) to provide the same high-quality patient experience across health care practices, 2) to streamline health care operations and promote more efficient utilization of resources, and 3) to improve quality and outcomes.[156]

Table 2 Potential domains for accreditation for an atrial fibrillation center of excellence

DOMAINS	SPECIFIC COMPONENTS
PATIENT IDENTIFICATION	Metrics for identification of patients who can benefit from AF center care
ACCESS	Metrics for timely and equitable access to an AF center
INTEGRATED CARE	Metrics for provision of multidisciplinary and integrated care
GUIDELINE-DIRECTED CARE	Metrics for evaluation of patients with AF, stroke prevention, rate control, and rhythm control
PREVENTION	Risk factor modification
EP LABORATORY-BASED CARE	Metrics for assurance of safe and effective practice
SURGICAL-BASED CARE	Metrics for assurance of safe and effective practice
PATIENT EDUCATION	Metrics for patient knowledge, understanding, and adherence
PROVIDER EDUCATION	Maintenance of continued education specific to AF

AF = atrial fibrillation; EP = electrophysiology.

Leadership

While there are several practice guidelines for the evaluation and management of AF, there is no primary organization to turn to for health care systems interested in establishing an AF center. Because there are many facets of AF care, no one organization has taken sole leadership of AF patient care implementation. Since all care should be patient-centered and because SDM is becoming increasingly important, patient organizations also should be involved in the creation of AF CoEs. Collaboration among many stakeholders is necessary to successfully create and implement AF CoEs.

Complexity

A single AF CoE model may not be generalizable (or desirable) due to the large variation in health care structure, delivery, and reimbursement models across the world. These factors will certainly vary from country to country, but there also will be significant differences within countries, between urban and rural areas, and among different health care system models that range from fee-for-service to fully integrated. Therefore, the processes by which to define and assess AF CoEs should be dynamic, focused on care processes and outcomes rather than care structures, and adaptive in a changing worldwide health care environment.

Communication and patient education

Almost all cardiac organizations have professional and patient education information on AF; however, these resources are often proprietary and limited. There still is a need for a comprehensive online site with accessible and integrated resources for professionals and patients (with separate portals and content for each). These resources should include educational videos, documents with information on guideline-driven care, risk score algorithms for stroke and bleeding prevention, and guidance on therapies such as catheter ablation. Patients would have access to expert advice, community resources, and educational information on how to live with AF and maximize QoL. Developing content with patient organizations as partners is also an important goal in the effort to improve AF-related education.

Policy

Most policy makers in local, regional, and national governments are asked to advocate for specific public health priorities such as cardiovascular disease. The American Heart Association and American College of Cardiology have legislative days that are organized to influence policy decisions to support cardiovascular health. Currently, there are no bills in the United States involving the care of patients with AF. In Europe, Bristol-Myers Squibb and Pfizer initiated and funded a project endorsed by many health care organizations to work with policy makers to improve AF patient care. The goal was to increase public awareness of AF, address system deficiencies (such as limited patient education and underdetection and diagnosis of AF), improve adherence to guidelines, and reduce underuse of OAC therapy in all AF patients at increased risk of stroke.[157]

Gaps in care

To date, there are well-documented gaps in the effective and appropriate use of AF treatments in certain patient groups,

but they have not been fully addressed to ensure optimal patient outcomes. Prior work in Europe has shown that AF patients with higher socioeconomic status, urban residence, and higher educational achievements were more likely to receive stroke prevention treatment and experience better outcomes.[158–161] Reviews of sex and racial/ethnic differences have found disparities of care for women and individuals with AF from certain ethnic groups when compared with Caucasian males. Women and blacks have been found to 1) often experience longer lasting and more frequent symptomatic AF episodes with worse QoL,[48,162–167] 2) have more drug-related adverse events,[167,168] 3) receive less stroke prevention treatment, 4) receive less aggressive treatment to maintain sinus rhythm,[48,167–171] and 5) have a higher adjusted mortality risk.[169] Eliminating disparities should be a core goal of AF CoEs.

Challenges

There are many challenges that complicate the development and implementation of AF CoEs. As previously noted, the European Society of Cardiology AF guidelines recommend (for class IIa, level B) that "an integrated approach with structured organization of care and follow-up should be considered in all patients with AF, aiming to improve guidelines adherence and to reduce hospitalizations and mortality (Class IIa; Level B)."[5] One of the most notable opportunities and challenges to an integrated approach is the coordinated involvement of many stakeholders.

Another major challenge in building AF CoEs is translating the theory of integrated and multidisciplinary into clinical practice. Today, a patient is diagnosed with AF once there is an electrocardiographic diagnosis of the arrhythmia. The iterative treatment cycle involves stroke prevention, risk factor and lifestyle modification, and determination of the best strategy for arrhythmia management. This typically requires a provider to shepherd the patient to various providers, who are often practicing at disparate locations. This is resource intensive and inefficient, and it is not surprising that patients "fall through the cracks." There are many examples of patients "falling through the cracks" in the literature. In a recent retrospective observational study of nearly 95,000 patients with known AF who presented with an acute ischemic stroke, 84% of high-risk patients (CHA_2DS_2-VASc score ≥ 2) were receiving neither warfarin nor a direct oral anticoagulant.[172] In another recent study of 254 patients with persistent AF, 66% of high-risk patients were never screened for obstructive sleep apnea.[173] In the United States and in other parts of the world, fee-for-service systems offer challenges to integrated care (Figure 4).

The concept of AF CoE is well aligned with the transformation to a value-based health care delivery system. Well-designed centers create opportunities for standardized protocols to assess stroke risk and initiate anticoagulation in high-risk patients, employ telemedicine and remote monitoring for follow-up, and coordinate care and educate patients to ensure optimal adherence to prescribed therapy. As an example, requiring eligible providers participating in the Centers for Medicare & Medicaid Services–based MIPS program to determine the CHA_2DS_2-VASc score in patients with nonvalvular AF or atrial flutter as a quality measure could enhance patient outcomes and result in a financial bonus for high-performing clinicians and health care organizations.

As previously discussed, a patient navigator, a patient educator, and other infrastructural positions can be essential to improving patient experiences and outcomes. However, since these coordinating functions are not direct revenue-generating positions, it can be difficult to find funding for them or additional positions that support the effective execution of AF center goals. A paradigm shift from fee-for-service models to value-based reimbursement models, in which health care providers are reimbursed for the care coordination of chronic diseases like AF, is critical to make the widespread use of AF CoEs an economically viable approach in which the care of AF patients is maximized.

Given the need to build programs that bring patients and their caregivers together with a variety of different clinical providers, collaboration among professional societies will be mandatory. Professional societies will need to coordinate efforts to establish the standards of care to which centers will be held accountable, develop mechanisms to permit all participating centers to achieve excellent outcomes, institute ways to benchmark "best practice" clinical and economic approaches that result in CQI, facilitate transparency, and propose economic models that reward excellence in order to move these initiatives forward. If done in a transparent and collaborative manner, leadership has the potential to transform health care delivery in a variety of clinical settings.

Section 10 Potential role of HRS

HRS is an international organization with a vision "to end death and suffering due to heart rhythm disorders." The mission of HRS is "to improve the care of patients by promoting research, education, and optimal health care policies and standards." Thus, HRS, in partnership with other heart rhythm professional societies, has a responsibility to define the standards for AF care delivery and develop programs that will generate the realization of these aspirations. If developed effectively, these programs can minimize gaps in the delivery of care; decrease variation in geographic, institutional, and individual care; reduce the costs of AF care; and ultimately improve patient outcomes.

While there are many potential ways to reach this goal, an AF CoE approach should prioritize and emphasize the following actions:

- Establish guideline-driven, consensus-based standards for clinical care of AF and procedural outcomes (ie, success and complications)
- Create protocols and processes that standardize and improve the quality of delivered AF care by participating AF centers

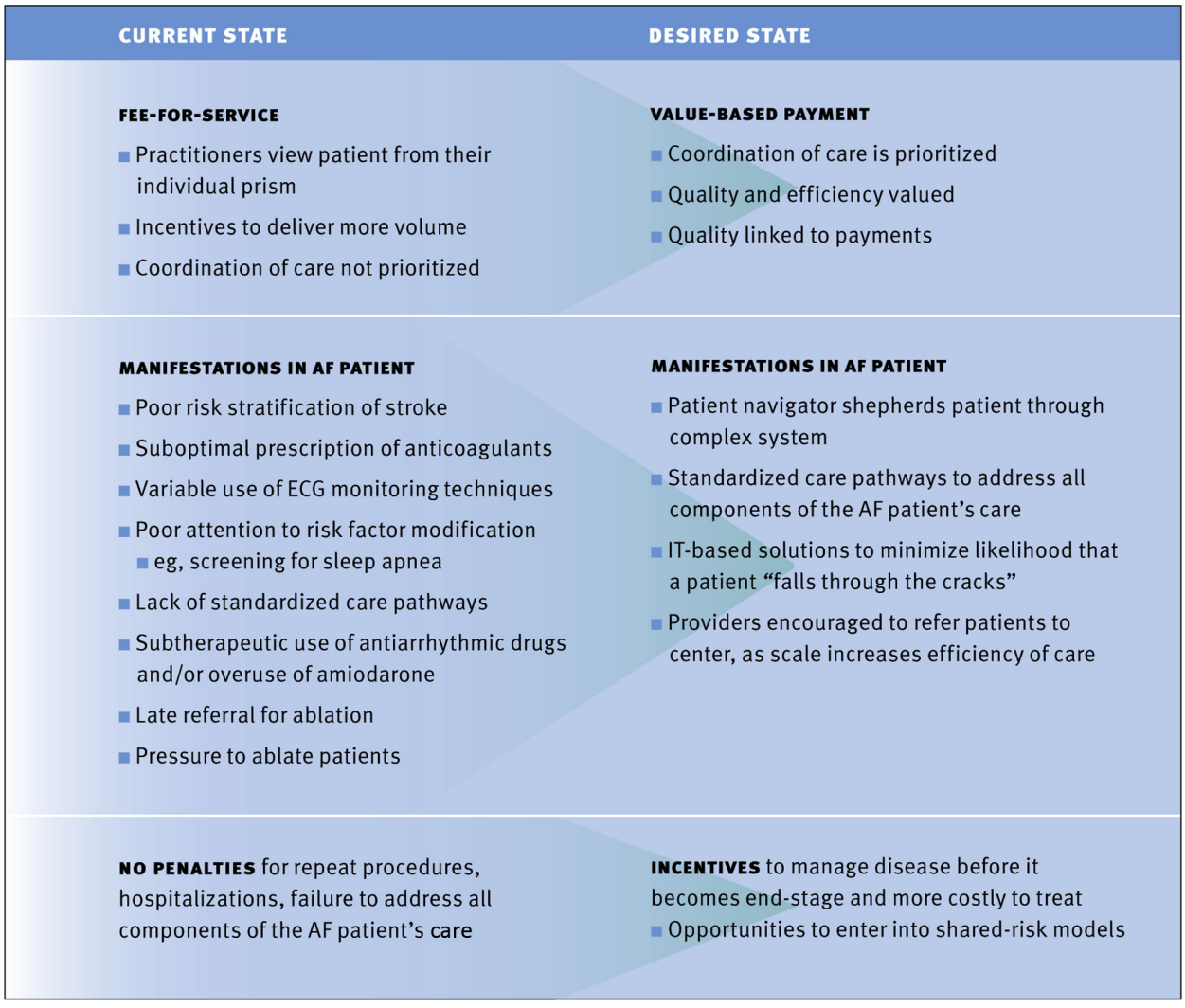

Figure 4 The difference between current and desired state for management of patients with atrial fibrillation (AF). Value-based health care is well suited to development of centers of excellence for disease such as AF. ECG = electrocardiogram; IT = information technology.

- Form best practice outcome metrics that will evolve over time to ensure that the quality of delivered care consistently improves everywhere
- Develop CQI programs to assist institutions and clinicians to achieve guideline-driven quality care
- Ensure transparency to prioritize patient outcomes
- Innovate to generate accurate registry data that minimize inconvenience and cost

In order to translate these aspirational goals into meaningful change in clinical practice, HRS will need to connect effectively with all of the relevant stakeholders and with other professional societies.

Engagement of essential stakeholders

Broad stakeholder engagement is crucial for the short-term and long-term success of AF centers and AF care in general (Figure 5). Engagement of, and support from, multiple domestic and international cardiovascular societies and noncardiovascular specialty societies will be essential given the existing fragmented manner in which AF care is currently delivered. Engagement with clinician societies should be diverse and include organizations like the American Association of Nurse Practitioners and the American Academy of Physician Assistants, among others. Clinicians of all types will need to be educated on best practices and coordinated into team-based programs, supported by health care systems. Patient groups and advocacy organizations are also key stakeholders, particularly in defining patient-centered care. It would be a mistake to not include industry in the key partners required to improve AF care. Collaboration with industry partners providing services, eg, EHR vendors and products (eg, device and pharmaceutical companies), will be needed to ensure that cost-effective care is preferred and delivered. For example, engagement with EHR vendors may enable an "AF Corner" in the EMR where AF-related data and management information can be easily accessed.

Given the movement toward a world in which value creation will become the primary method of compensation, HRS will need to proactively engage entities that define how care

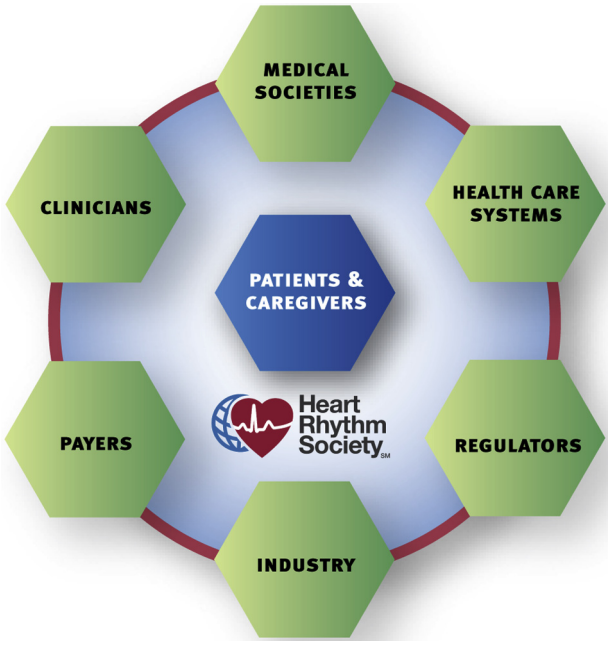

Figure 5 Conceptual model for stakeholder input for atrial fibrillation centers of excellence design and implementation.

will be delivered and compensated. These include organizations (such as the National Quality Forum) that work to advance their primary goals of promoting prevention, developing patient- and caregiver-centered care programs, facilitating care coordination, reducing care disparity, and introducing meaningful information technology solutions by establishing institutional and individual health care quality-based practice criteria. Discussions with payers will also be necessary to ensure that reimbursement models are updated to encourage health care providers to develop integrated and coordinated care programs.

We are entering a new world in which we must choose between being observers and recipients of solutions provided by external organizations, or visionaries, who create solutions to define the manner in which AF health care will be delivered. By effectively developing the AF CoE concept, we can create a care-delivery model that can be emulated to augment cardiovascular and general patient outcomes globally.

Section 11 Conclusion and next steps

The successful management of AF requires attention to the four pillars of AF care: risk factor management, stroke prevention, rate control, and rhythm control. While these goals are applied to individual patients, the health care delivery model is also critically important. AF centers represent an opportunity to ensure that AF care is not only patient-centered but also integrated and team-based. While the four goals of AF care do not change in an AF CoE, there are guiding principles that should direct the development and implementation of any AF CoE. While no list could be exhaustive, there are seven key principles that are core to the concept of the AF CoE (Figure 6).

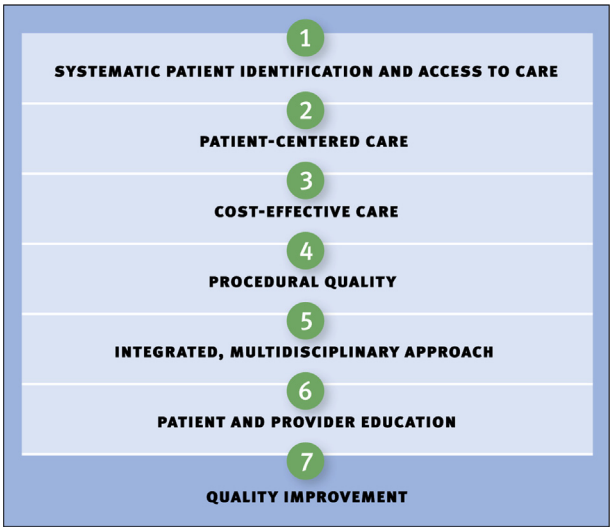

Figure 6 Seven core principles for atrial fibrillation centers of excellence design and implementation.

If AF centers are to be truly innovative and state of the art, they must ensure that all patients with AF are identified and have equal access. The care in these centers must be patient-centered, with the patient experience set as a key focal point for all design and implementation consideration. The care must be cost-effective so it can be sustainable in the long term. Procedural care must provide quality outcomes including safety and efficacy. All care needs to be integrated and applied with a multidisciplinary and team-based approach. Finally, each AF CoE must commit to the principles and processes of quality improvement. Moving forward, HRS will work with other professional societies and stakeholders to begin to determine how these principles will be codified and operationally defined in the context of the four goals of AF care. Clearly, the future of AF care is poised for change, and the time to improve our care delivery is now.

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Appendix 3

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Number value: 0 = $0; **1** = ≤$10,000; **2** = >$10,000 to ≤$25,000; **3** = >$25,000 to ≤$50,000; **4** = >$50,000 to ≤$100,000; **5** = >$100,000 to ≤$200,000; **6** = >$200,000 to ≤$300,000; **7** = >$300,000 to ≤$400,000; **8** = >$400,000.

ABIM = American Board of Internal Medicine; NCDR = National Cardiovascular Data Registry; NIH = National Institutes of Health.

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Appendix 4

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NIH = National Institutes of Health.

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